



**Course Syllabus for
DAUSY National Ph.D. Program in Autonomous Systems
(year 2023-24)**

Course title	Multi-agent and multi-object estimation
Scientific Discipline Sector	ING-INF/04
Hours of instruction	20 hours
CFU	2 CFU
Semester, period	January-February 2024
Goal	The course will provide an overview of advanced research in estimation, specifically concerning the two topics of multi-agent and multi-object estimation. Multi-agent estimation deals with a network of agents with sensing, processing and communication capabilities that aim to cooperatively monitor a given system of interest. Multi-object estimation aims to detect an unknown number of objects present in a given area and estimate their states. Special attention will be devoted to the Kullback-Leibler paradigm for fusion of possibly correlated information from multiple agents and on the random-finite-set paradigm for the statistical representation of multiple objects. Applications to distributed cooperative surveillance, monitoring and navigation tasks will be discussed.
Syllabus	<p>Recalls on Bayesian filtering.</p> <p>Network modeling and Bayesian approach to multi-object estimation.</p> <p>Kullback-Leibler fusion and its properties.</p> <p>Scalable fusion via consensus.</p> <p>Distributed Kalman filtering with guaranteed stability.</p> <p>Event-triggered communication for enhanced efficiency.</p> <p>Random-finite-set (RFS) modeling of multi-objects.</p> <p>Multi-object filtering.</p> <p>Multi-object fusion.</p> <p>Applications to multi-target tracking, simultaneous localization and mapping (SLAM), source detection and localization.</p>
Bibliography	Slides and supporting material from the lecturer.
Examination method	End-course examination based on either a test or an optional project proposed by the student.